COMPUTEREX
X-RAY & ISOTOPE
EXPOSURE CALCULATOR

USING YOUR COMPUTEREX

THE COMPUTEREX WILL EASILY AND QUICKLY DETERMINE THE CORRECT MILLIAMPERE-MINUTES FOR X-RADIOGRAPHY OR CURIE-MINUTES FOR GAMMA-RADIOGRAPHY FOR ANY SELECTED THICKNESS OF STEEL, ALUMINUM, OR MAGNESIUM.

EXPOSURE TIMES AS CALCULATED ON THE COMPUTEREX ARE BASED ON THREE COMMONLY EMPLOYED STANDARDS:

1. TARGET TO FILM DISTANCE OF 36 INCHES
2. OVERALL FILM DENSITY OF 1.5
3. USE OF A CLASS II FILM SUCH AS KODAK AA EQUAL TO FILM SPEED OF 1.0

THE CALCULATOR EASILY CORRECTS FOR VARIATIONS IN ANY ONE OR ALL OF THE ABOVE PARAMETERS. DIRECTIONS FOR MANIPULATION OF THE COMPUTEREX TO DETERMINE CORRECTED TIMES WHEN CHANGING THESE VARIABLE FACTORS ARE PRINTED ON THE SLIDE RULE, STEPS 1-5.

A DETAILED EXPLANATION OF THESE STEPS FOLLOW. A FEW MINUTES SPENT IN PRACTICING TYPICAL EXPOSURE PROBLEMS WILL BE VERY HELPFUL IN GAINING UNDERSTANDING AND DEXTERITY IN HANDLING THE COMPUTEREX.

1. "Set indicator opposite thickness of metal. . . ". This first step is to determine milliampere minutes (mam) for aluminum, magnesium, or steel at various kilovoltages (KVP); or Curie-minutes (Ci-min) for steel when using Iridium ^{192} (Ir) or Cobalt ^{60} (Co). This is done by locating THICKNESS IN INCHES column on the front left side of the calculator (the side with the name COMPUTEREX). Then move the slide to the desired thickness. For example, a 1" thick steel part shows 175 KVP @ 60 mam, 200 KVP @ 24 mam, etc. (This is found at the top front, under STEEL.) At the same time we can find Curie-minutes for Iridium or Cobalt at the front right of the calculator. Ir = 265 Ci-min, or 47 Ci-min for Co. You will also note at the bottom front varying KVP and mam for aluminum and magnesium.

2. The second step is simply a division scale to indicate a correct time, in minutes for a specified milliamperaged or curiage. As above radiographing a 1" steel forging using 200 KVP we find 24 mam. Turn the rule over to the back side and at the top left side you will see CURIE-MIN., MILLIAMPERE-MIN, CURIES, and MILLIAMPERES. Move the slide to the right and set the large arrow at 24 mam. At the left side you will see MILLIAMPERES and MINUTES. Depending on the capabilities of the equipment available, use any multiple of ma and minutes that will equal the 24 mam required. i.e. 10 ma @ 2.4 minutes, 5 ma @ 4.8 minutes, 8 ma @ 3 minutes, etc.

3. A 3' distance (FFD) is the standard for this calculator. For other than a 3' FFD you must move the 3' distance arrow to minutes previously determined. Using the above example of 1" of steel will require 200 KVP @ 24 mam or 200 KVP @ 6 ma for 4 minutes. 4 minutes is our minutes previously determined. However, we want to change the distance to 4' so we must determine a new time. Move the slide so the 3' distance arrow is below 4 minutes. Look to the right of the 3' distance until you see the 4' distance mark. Directly above is 7.2 minutes. Therefore, 7.2 minutes is our new time with a distance (FFD) of 4 feet. (If a 5' FFD is necessary, the time would be 11.1 minutes.)
4. Since a 1.5 density is another standard for the COMPUTEREX, for other than 1.5 density we must determine a new time. Continuing with the same example, we now assume that we need a density of 2.0. Our previously determined time is 7.2 minutes; move the slide until 1.5 density arrow (at the bottom) is above 7.2 minutes. Look to the right and directly below 2.0 density is 10.1 minutes. Therefore, 10.1 minutes is our new time for a density of 2.0. (A 3.0 density would have a time of 16.5 minutes.)
5. The last variable is film speed. The standard used is AA film with a factor of 1.00. For other than AA film move the film factor arrow (at the bottom) to minutes previously determined and read new time opposite film factor that you have chosen. Completing the problem, our customer would settle for less detail to gain production time for the same 1" steel forging, so we are going to use a faster film, Ansco C. From above (step 4), our previously determined time is 10.1 minutes. Move slide so film speed factor of 1.00 is above 10.1 minutes. Ansco C with lead screens has a film speed factor of .40 (from bottom left corner of FILM SPEED FACTORS section). Looking to the left of FILM FACTOR 1.00 and note below .40, is the new time of 4 minutes. Thus, 4 minutes is the new time using Ansco C film.

   A summary of the above problem is as follows: What KVP at what mam is necessary to radiograph a 1" thick steel forging at a distance of 4 feet having a density of 2.0 and using Ansco C film with lead screens.

   1. 1" steel at 200 KVP = 24 mam
   2. 24 mam = 6 ma @ 4 minutes
   3. 4' distance = 7.2 minutes
   4. 2.0 density = 10.1 minutes
   5. C film (.40) = 4 minutes

Before you spoil any film, try these following problems using the steps 1-5.

Problem 1. Radiograph a 1-7/8 inch aluminum weldment (ground flat on both sides) using the following parameters:

Source:	120 KVP
Intensity:	4 ma
FFD:	4'
Density:	2.0
Film:	M
Screens:	None
Answer:	12.6 minutes

Problem 2. Radiograph a 2" steel casting using following parameters:

Source:	300 KVP
Intensity:	5 ma
FFD:	60"
Density:	2.5
Film:	AA
Screens:	Using screens
Answer:	18.1 minutes

Problem 3. Radiograph a 2" steel weldment (ground flat on both sides) using following parameters:

Source:	Ir^{192} 4 weeks old
Intensity:	100 Ci
FFD:	4 feet
Density:	2.0
Film:	AA
Screens:	Using screens
Answer:	28 minutes

Problem 4. Radiograph a 1-3/8 inch steel weldment (ground flat on both sides) using following parameters:

Source:	Ir^{192} 9 weeks old
Intensity:	100 Ci
FFD:	4 feet
Density:	2.0
Film:	AA
Screens:	Using screens
Answer:	18.5 minutes

In some instances it may be necessary to multiply curie-minutes by 10 so slide is not too far to the left, as in step 2 of the above problem. As noted, 1-3/8 inches of steel requires 400 curie minutes. A 9 week old 100 Ci source of Ir has a present strength of only 55 Ci. If you move large arrow under 400 Ci-min and look for 55 curies, the slide is too far to the left to get a reading. Therefore, multiply 400 Ci-min by 10 and move slide to the right until large arrow is under 4,000 Ci-min. Now look under 55 curies and answer is 73 minutes. Don't forget to divide by 10 and proceed with correct time of 7.3 minutes.

Remember: "practice makes perfect" – spend a few minutes now and get perfect radiographs every time.

COMPUTEREX X-RAY & ISOTOPE EXPOSURE CALCULATOR

HERG MANUFACTURING CO.

San Francisco, California

THICKNESS IN INCHES

⅛ ¼ ⅜ ½ ⅝ ¾ ⅞ 1 1⅛ 1¼ 1⅜ 1½ 1⅝ 1¾ 1⅞ 2 2⅛ 2¼ 2⅜ 2½ 2⅝ 2¾ 2⅞ 3 3⅛ 3¼ 3⅜ 3½ 3⅝ 3¾ 3⅞ 4 4⅛ 4¼ 4⅜ 4½ 4⅝ 4¾ 4⅞ 5 5⅛ 5¼ 5⅜ 5½ 5⅝ 5¾ 5⅞ 6

DIRECTIONS FOR X-RAY CALCULATIONS:

Basic technics are calculated with Kodak AA film, using a 3′ focal-film distance, for a film density of 1.5. For factors other than these see Note directly below.

1. Set indicator opposite thickness of metal to be radiographed. Read milliampere-minutes opposite selected kvp in proper slot.

Note: Use other side of calculator to adjust for variations in film speed, density and distance. To ascertain exposure time in minutes use other side of calculator or the following formula:

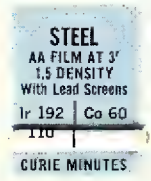
$$\frac{\text{Milliampere-Minutes}}{\text{Milliampere}} = \text{exposure time in minutes}$$

EXAMPLE: Given — 1″ steel, 6 ma and 200 kvp.
Set indicator at thickness of 1 inch.
Read 24 ma-min at steel 200 kvp slot.

$$\frac{24 \text{ ma-min}}{6 \text{ ma}} = 4 \text{ min exposure at } 3'.$$

DIRECTIONS FOR ISOTOPE CALCULATIONS:

1. Set indicator opposite thickness of metal to be radiographed. Read curie-minutes opposite selected isotope in proper slot.



Note: Use other side of calculator to adjust for variations in film speed, density and distance. To ascertain exposure time in minutes use other side of calculator or the following formula:

$$\frac{\text{Curie-Minutes}}{\text{Curies}} = \text{exposure time in minutes}$$

EXAMPLE: Given — 3″ steel, Co 60 and 8 curies.
Set indicator at thickness 3 inches.
Read 240 Ci-min at Steel Co 60 slot.

$$\frac{240 \text{ Ci-min}}{8 \text{ Ci}} = 30 \text{ min exposure at } 3'.$$

DIRECTIONS FOR DETERMINING CURIE STRENGTH:

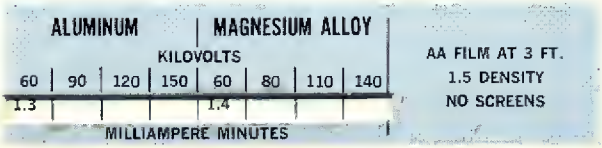
1. From the DECAY TABLE at right select factor opposite appropriate isotope.

2. Multiply the original calibrated curie strength by the factor to obtain current curie strength.

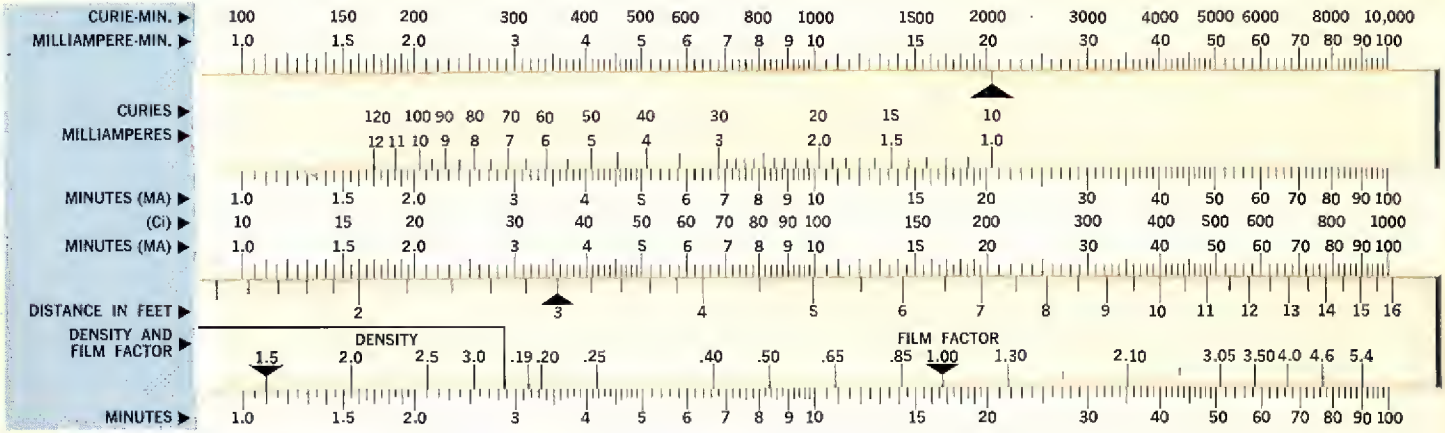
EXAMPLE: 20 Ci, Co 60 — 3 yrs old. Factor = .67
.67 x 20 Ci = 13.4 Ci present curie strength

DECAY TABLE

Co 60		Ir 192	
AGE (Yrs)	FACTORS	AGE (Wks)	FACTORS
½	.94	1	.94
1	.88	2	.88
1½	.82	3	.82
2	.77	4	.77
2½	.72	5	.72
3	.67	7	.63
3½	.63	9	.55
4	.59	11	.49
4½	.55	13	.43
5	.51	15	.38



Slide Chart by PERRYGRAF Div. Nashua Corporation, Elmhurst, Ill.



FILM SPEED FACTORS

FILM	FACTORS		
	WITHOUT LEAD SCREENS	WITH LEAD SCREENS	ISOTOPE WITH LEAD SCREENS
Du Pont 510	4.0	5.4	3.05
Gevaert D-4	4.0	4.6	3.05
Kodak M	4.0	4.6	3.05
Ansco B	1.3	3.5	2.10
Du Pont 506	1.0	1.0	1.0
Gevaert D-7	1.0	1.0	1.0
Kodak AA	1.0	1.0	1.0
Ansco A	1.0	1.0	1.0
Du Pont 504	.65	.85	—
Ansco C	.25	.40	.50

DIRECTIONS (Continued)

2. Set large arrow ▲ at milliampere-minutes or curie-minutes (from step 1). Read minutes opposite desired milliampere or curie. Slanted figures represent curies and curie-minutes.

VARIABLES:

3. **DISTANCE.** For other than 3', set large 3' distance arrow ▲3 at minutes previously determined. Read corrected minutes opposite desired distance.
4. **DENSITY.** For other than 1.5, set large density arrow 1.5▼ at minutes previously determined. Read corrected minutes opposite desired density.
5. **FILM SPEED.** For other than AA film, set large film factor arrow 1.0▼ at minutes previously determined. Read corrected minutes opposite new film factor.

EXAMPLES

1. 1½" Steel at 250 kvp = 25 ma-min.
2. 10 ma = 2.5 min.
3. 4' distance = 4.5 min.
4. 2 density = 6.3 min.
5. M film (4.6) = 29 min.

1. 3" Steel at Ir 192 = 2600 Ci-min.
2. 100 Ci = 26 min.
3. 5' distance = 72 min.
4. 2 density = 102 min.
5. C film (.50) = 51 min.